PATENT ABSTRACTS OF JAPAN

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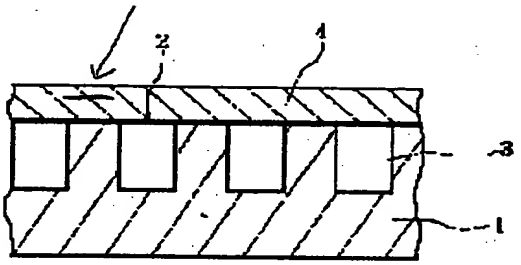
(21)Application number : 10-219659
(22)Date of filing : 17.07.1998

(71)Applicant : C UYEMURA & CO LTD
(72)Inventor : IKEDA KONOSUKE
MURAKAMI TORU

(54) METAL SEPARATOR FOR FUEL CELL

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a metal separator for a fuel cell, which has a low contact resistance, excellent water repellency, and good anti-corrosiveness.
SOLUTION: A fuel cell module is equipped with positive and a negative electrodes and electrolyte interposed between them, wherein a metal separator 1 is installed on each side of the module and is furnished with a groove 3 for gas flowing, and the surface of this groove at least is lined with a noble metal composite plating film consisting of entectoid of fluoro-resin or graphite fluoride particles. These separators 1 for fuel cell may be used in the same manner as a conventional separator, in particular favorably used in a fuel cell with a solid highpolymer electrolyte, and have low contact resistance, excellent water repellency at the groove 3, and good gas flowing possibility, and further an excellent anti-corrosiveness owing to the noble metal as matrix.



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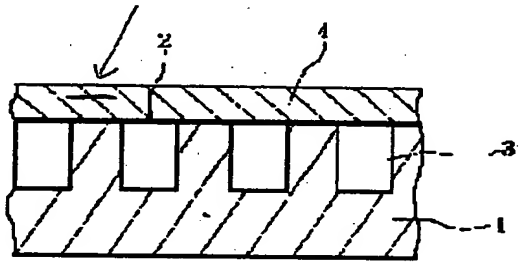

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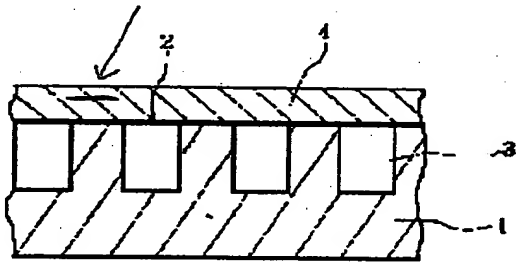

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates to the metal separator used for a fuel cell, especially a solid-state macromolecule type fuel cell.
[0002]
[Description of the Prior Art] A fuel cell, for example, a solid-state macromolecule type fuel cell etc., arranges the metal separator with which the slot of gas-stream popular use was usually formed in the both sides of the module which made electrolytes, such as ion exchange membrane, intervene between positive/negative poles, and although it has the composition which installed two or more these, as this metal separator, the carbon board, gilding, the stainless steel board which carried out platinum plating, etc. are used conventionally.
[0003] By the way, the property for which a metal separator is asked When it explains with reference to drawing 1 , contact resistance with the carbon paper 4 in the front face (contact section 2) of a separator 1 etc. is small, The passage (slot 3 formed in the separator 1) of gas is not blockaded with the water which hydrogen oxidized and was produced, but there is no disturbance by waterdrop, and circulation of gas is good, Not to corrode, even if it pours cooling water is demanded, and that corrosion resistance is still better, it being a low cost, a lightweight thing, etc. are required. If the moisture made on the boundary of an air pole and an electrolyte is not removed while water adheres and a gas passageway blockades if the contact resistance of a separator has the bad water repellence of making it as small as possible and a separator slot since useless voltage will be especially consumed if contact resistance is large, it is the portion into which this moisture interfered, and since the reaction of an air pole will not progress, water repellence is searched for.
[0004] however, since a carbon board is not excellent in conductivity and press working of sheet metal etc. could not do it easily, when a separator was formed with a carbon board, although cutting was carried out and the slot of gas-stream ** was attached, a weight is large, cutting expense is high, and it is cost quantity -- etc. -- there was a fault Moreover, the slot had the fault of that a conversion cost becomes high, a covering fluororesin tending to exfoliate, although fluororesin covering was carried out.
[0005] Possibility that a micropore may open for a material on the other hand since processability is not so good, although press working of sheet metal is possible for materials, such as SUS, gas leaks. and it becomes impossible to satisfy the performance as a separator of gas is also large. Then, when the slot was cut with etching, there was a problem of it having been heavy and becoming cost quantity.
[0006] Furthermore, there was a fault that above both of the water repellence of a slot were not good.
[0007] that by which this invention was made in view of the above-mentioned situation -- it is -- contact resistance -- low -- water repellence -- excelling -- a fuel cell with corrosion resistance good moreover -- public funds -- it aims at offering a group separator
[0008]
[A The means for solving a technical problem and the gestalt of implementation of invention] the fuel cell in which this invention has been arranged at the both sides of the fuel cell module equipped with the electrolyte which intervened between the positive electrode, the negative electrode, and these positive/negative pole in order to attain the above-mentioned purpose, and the slot of gas-stream popular use was formed -- public funds -- the fuel cell characterized by forming in the above-mentioned slot front face at least the noble-metals composite-coatings coat in which the fluororesin or the graphite fluoride particle carried out the eutectoid in a group separator -- public funds -- a group separator is offered
[0009] In this case, although the above-mentioned noble-metals composite coatings may give noble-metals composite coatings to a slot and may give the usual gilding etc. to the contact section even if it gives them to the whole separator including a slot, it is desirable from a working plane, a cost side, etc. to give noble-metals composite coatings to the whole separator.
[0010] There is no un-[which the top where contact resistance is small, and water repellence are high since, as for the separator of this invention, the compounded distribution, eutectoid, and noble-metals composite-coatings coat is uniformly formed for the fluororesin or graphite fluoride particle into the noble-metals matrix, such as Pt, Au, Pd, and Ag,, the water repellence of a slot is good, moisture removal is made easily, and water adheres / un-/ to a slot, and makes a gas passageway blockade] arranging, and the distributivity of gas is Moreover, corrosion resistance is also excellent.
[0011] Hereafter, lessons is taken from this invention and it explains in more detail.
[0012] As for the metal separator for fuel cells of this invention, an eutectoid and the distributed noble-metals composite-coatings coat are formed in a gas-stream popular use slot front face for a fluororesin or a graphite fluoride particle

into a noble-metals matrix at least.
[0013] lightweight, although a well-known thing is conventionally used as this separator material, for example, aluminum, a stainless steel, titanium, etc. can be used here -- etc. -- it is desirable that it is made from an aluminum plate at a point
[0014] When giving noble-metals composite coatings to such a metal material, after removing an oxide film using an acid to well-known pretreatment according to the kind of the material, for example, an aluminum material, in the case of zinc substitution processing, a stainless steel, or titanium, strike nickel-plating processing using wood nickel-plating liquid is performed.
[0015] In this case, when a ground plating coat can be formed after such pretreatment and zinc substitution processing especially of the aluminum is carried out, it is desirable to perform noble-metals composite coatings through a ground plating coat. As this ground plating coat, nickel-alloy plating coats, such as a nickel or nickel-Lynn alloy, can be formed, and a ground plating film with a thickness of about 1-50 micrometers can be formed by well-known electric nickel plating or the non-electrolyzed nickel-plating method.
[0016] Noble-metals composite coatings can be performed using the composite-coatings liquid which distributed the eutectoid particle (water-repellent particle) which becomes the well-known electric noble-metals plating liquid containing the water-soluble salt of noble metals, such as Pt, Au, Pd, and Ag, from a fluororesin or a graphite fluoride particle.
[0017] Here, specifically, the detailed powder (about 0.1 - about 3-micrometer particle size) of resins which carried out the fluoridation, such as graphite fluoride, PTFE (polytetrafluoroethylene), FEP (full ORONEI Ted ethylene propylene) and PFA (a tetrafluoroethylene / perfluoroalkylvinyl ether copolymer), ETFE (ethylene / tetrafluoroethylene copolymer), PVDF (poly vinylidene fluoride), and ECTFE (ethylene / chlorotrifluoroethylene copolymer), can use it suitably as an eutectoid particle.
[0018] Since it is hard to get wet in water, as for these, it is good to use a well-known surfactant and to make it distribute by the well-known method. For distribution and an eutectoid, a cationic surface active agent can use it suitably. What has the thing and perfluoro alkyl group which have a long-chain hydrocarbon group as hydrophobic groups as a cationic surface active agent can be used. For example, they are a dodecyltrimethylammonium bromide, dodecyl benzyl dimethylannmonium chloride, perfluoro alkyl trimethylammonium bromide, etc.
[0019] In addition, the amount of these eutectoids particle used is selected suitably, and is added in an amount from which the amount of composites (the amount of eutectoids) mentioned later is obtained.
[0020] It is desirable for performing composite coatings using the above-mentioned noble-metals composite-coatings liquid to face and to use convenient liquid churning and a liquid cyclic process for distributing the particulate material which carries out an eutectoid. If plating liquid is put, since it will precipitate downward or it will float upwards, it is good to carry out liquid circulation loosely.
[0021] Plating appearance will tend to become uniform if a plating article is rocked. in addition, the plating liquid (matrix plating liquid) with which plating conditions, such as solution temperature, pH, and current density, do not contain an eutectoid particle -- being the same .
[0022] in the above-mentioned eutectoid particle, distribution and uniformly although [coat / plating / which is obtained using such noble-metals composite-coatings liquid / inside / of a noble-metals matrix] it comes to carry out an eutectoid, the amount of composites to the inside of the plating coat of an eutectoid particle (the amount of eutectoids) is about two to 30 vol% -- desirable -- especially -- about 10 -- water repellence is high in it being the amount of composites beyond vol% Moreover, although the eutectoid particle is carrying out the outcrop to the front face, if a part of fluororesin which heated and carried out the eutectoid of the plating coat is fused, water repellence of this plating coat will improve further.
[0023] Moreover, when the eutectoid of the fluororesin is carried out and the contact angle with the water of the above-mentioned plating coat carries out the eutectoid of about 110-60 degrees and the graphite fluoride particle, it is about 150-110 degrees.
[0024] In addition, although the thickness of the above-mentioned plating coat is also selected suitably, 0.2-20 micrometers is 1-15 micrometers especially.
[0025] In this invention, although [of the above-mentioned separator] the above-mentioned noble-metals composite-coatings coat is formed in a slot at least, this plating coat can be formed in both a slot and the contact section in this case, this composite-coatings coat can perform noble-metals plating which performs the above-mentioned composite coatings to a slot as occasion demands, and does not contain an eutectoid particle in the contact section, although contact resistance is a low thing, since matrices are noble metals, and a noble-metals plating coat can be formed. For example, Pt/PTFE composite coatings may be performed to a slot and you may plate with gold separately at the contact section. However, it is desirable to exfoliate, after appending and carrying out the mask of the resist in this case, for it to be necessary to exfoliate, after appending and galvanizing a resist in another place further, and for time and an effort to be applied, and for there to be a possibility of becoming a cost rise, therefore to galvanize a slot and the contact section simultaneously.
[0026]
[Effect of the Invention] The metal separator for fuel cells of this invention can be conventionally used in the same mode as a well-known separator. and although it is suitable as a separator of a solid-state polyelectrolyte type fuel cell, contact resistance is low. and the separator of this invention excels [contact resistance] in the water repellence of a slot, a good gas-stream denominator is secured. and since matrices are moreover noble metals, it is especially excellent [separator] also in corrosion resistance.
[0027]
[Example] Although an example is shown and this invention is explained concretely hereafter, this invention is not restricted to

the following example.
[0028] After performing pretreatment (zinc substitution processing and AZ process made from Kamimura Industry are used) which shows the gas circulation fluting separator made from aluminum of 200x184mm of ** outside [an example 1] below according to a conventional method, the 20-micrometer nickel-plating coat was formed using the electric nickel-plating liquid of the following composition, on it, the electric platinum composite-coatings liquid of the following composition was used, and the 0.5-micrometer compound platinum plating coat was formed.
Pretreatment alkali cleaner U-cleaner UA-68 (50 g/L, 50 degrees C, 5 minutes)
** backwashing-by-water alkaline etching agent AZ-102 (50 g/L, 60 degrees C, 30 seconds)
** backwashing-by-water JISUMATTO JISUMATTA AZ-201(200 g/L)+ nitric acid (800mL /L) (a room temperature, 30 seconds)
** backwashing-by-water zinc substitution AZ-301 (a room temperature, 1 minute)
Are ** backwashing-by-water nitric-acid immersed. Nitric-acid 800 mL/L (a room temperature, 30 seconds)
** backwashing-by-water zinc substitution AZ-301 (a room temperature, 1 minute)
Electric nickel-plating liquid and plating conditions Nickel sulfate 285 g/L Nickel chloride 45 g/L Boric acid 40 g/L pH 4.2 Solution temperature 55 degrees C Churning Compressed air agitation Cathode current density 5 A/dm2 Plating time The electrical-and-electric-equipment platinum composite-coatings liquid during 22 minutes, and plating conditions As H2Pt(NO2)2SO4Pt. 5 g/LPTFE 20g/L Dodecyl trimethylammonium chloride 2 g/L It is referred to as pH 2 with a sulfuric acid. 40 degrees C of solution temperature Cathode current density 0.5 A/dm2 Anode plate Pt Plating time For 4 minutes Churning Liquid churning by pump circulation [0029] As for the obtained platinum composite-coatings coat, PTFE (polytetrafluoroethylene) of the amount of eutectoids of PTFE was [the eutectoid and] 15vol(s)% dispersedly uniformly in platinum.
[0030] The carbon board was put on this galvanized separator, it pressed by planar pressure 5 kgf/cm2, and contact resistance with the carbon board of this separator was measured. Consequently, all resistance was the 5-20m ohmxcm 2, and was good. Furthermore, although the contact resistance after **(ing) for 100 days to the air containing a 75-degree C saturated steam as a corrosive environment was measured, increase of contact resistance was less than 5%.
[0031] Next, ion exchange membrane was made into the polyelectrolyte for the above-mentioned separator a 16-sheet pile and between them, the fuel cell which infixed the module which allotted the well-known oxygen electrode and the hydrogen electrode to the both sides was created, and the power generation examination of 100 hours was performed. As a result of measuring the contact resistance of the above-mentioned separator after a power generation examination, increase of contact resistance is less than 10%, and it became clear that there is almost no degradation in a separator.
[0032] Moreover, most degradation was not accepted but, as for the above-mentioned fuel cell, that the utilization factor of hydrogen and oxygen gas hardly falls made 100 hours after clear.
[0033] Furthermore, as a result of measuring the contact angle of the above-mentioned separator (platinum composite-coatings coat) and water before and after a power generation examination, the contact angle was 90-100 degrees, and water repellence was very good.
[0034] The separator was obtained like the example 1 except having used the electric silver composite-coatings liquid of the following composition, and having formed the 10-micrometer silver composite-coatings coat instead of the platinum composite coatings of the [example 2] example 1.
Electric silver composite-coatings liquid and plating conditions KAg2 (CN) They are 20g/L as Ag. KCN (free) 15 g/L Potassium carbonate 15 g/L PTFE 30 g/L Dodecyl benzyl dimethylannmonium chloride 3 g/L Solution temperature 25 degrees C Cathode current density 1 A/dm2 Churning Liquid churning by pump circulation [0035] the obtained silver composite-coatings coat -- PTFE -- 20vol(s)% -- the result which is carrying out the eutectoid, assembled the same fuel cell as an example 1, and performed the same examination was the same as that of an example 1

[Translation done.]

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審査請求　未請求　請求項の数１　ＦＤ　（全５頁）

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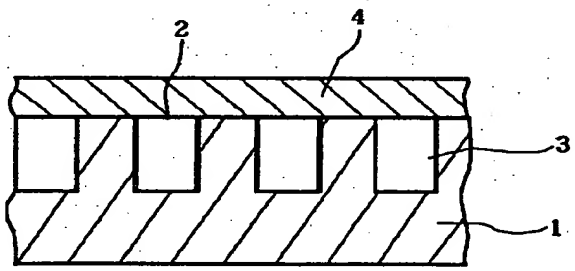
Ｆターム(参考)　5H026 AA06 BB04 CC03 EE02 EE06
EE19 HH03

(54)【発明の名称】　燃料電池用金属セパレーター

(57)【要約】
【解決手段】　正極、負極及びこれら正負極間に介在された電解質を備えた燃料電池モデュールの両側に配置され、ガス流通用の溝部が形成された燃料電池用金属セパレーターにおいて、少なくとも上記溝部表面にフッ素樹脂又はフッ化黒鉛粒子が共析した貴金属複合めっき皮膜を形成したことを特徴とする燃料電池用金属セパレーター。
【効果】　本発明の燃料電池用金属セパレーターは、従来公知のセパレーターと同様の態様で使用することができ、特に固体高分子電解質型の燃料電池のセパレーターとして好適であるが、本発明のセパレーターは、接触抵抗が低く、また溝部の撥水性に優れ、良好なガス流通性が確保され、しかもマトリックスが貴金属であるため、耐食性にも優れるものである。



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【特許請求の範囲】

【請求項1】　正極、負極及びこれら正負極間に介在された電解質を備えた燃料電池モデュールの両側に配置され、ガス流通用の溝部が形成された燃料電池用金属セパレーターにおいて、少なくとも上記溝部表面にフッ素樹脂又はフッ化黒鉛粒子が共析した貴金属複合めっき皮膜を形成したことを特徴とする燃料電池用金属セパレーター。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は、燃料電池、特に固体高分子型燃料電池に用いる金属セパレーターに関する。

【0002】

【従来の技術及び発明が解決しようとする課題】燃料電池、例えば固体高分子型燃料電池などは、通常、正負極間にイオン交換膜等の電解質を介在させたモデュールの両側にガス流通用の溝部が形成された金属セパレーターを配設し、これを複数個並設した構成を有するが、この金属セパレーターとしては、従来、炭素板、金めっきや白金めっきしたステンレス板などが使用されている。

【0003】ところで、金属セパレーターに求められる特性は、図1を参照して説明すると、セパレーター1の表面（接触部2）での炭素紙4などとの接触抵抗が小さいこと、水素が酸化されて生じた水によってガスの流路（セパレーター1に形成された溝部3）が閉塞されず、水滴による妨害がなく、ガスの流通が良好であること、冷却水を流しても腐蝕しないことが要求され、更に耐食性が良好であること、低コストであること、軽量であること等も要求される。特に、接触抵抗が大きいと無駄な電圧を消費するので、セパレーターの接触抵抗はできるだけ小さくすること、またセパレーター溝の撥水性が悪いと、水が付着し、ガス流路が閉塞すると共に、空気極と電解質との境界にできる水分を除去しなければ、この水分が邪魔をした部分で、空気極の反応が進まなくなるので、撥水性が求められる。

【0004】しかし、セパレーターを炭素板で形成した場合、炭素板は導電性が優れておらず、プレス加工などができにくいので、切削加工してガス流通の溝を付けていたが、重量が大きく、切削加工費が高く、コスト高であるなどの欠点があった。また、溝部にフッ素樹脂被覆していたが、加工費が高くなる、被覆フッ素樹脂が剥離し易いなどの欠点があった。

【0005】一方、SUSなどの素材では、プレス加工はできるが、加工性が余りよくないので、素材に微小孔があく可能性があり、ガスが漏れ、ガスのセパレーターとしての性能を満足できなくなる可能性も大きい。そこで、エッチングで溝を切ると、重くて、コスト高になるという問題があった。

【0006】更に、上記の両者共に、溝部の撥水性は良

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好ではないという欠点があった。

【0007】本発明は上記事情に鑑みなされたもので、接触抵抗が低く、撥水性に優れ、しかも耐食性の良好な燃料電池用金属セパレーターを提供することを目的とする。

【0008】

【課題を解決するための手段及び発明の実施の形態】本発明は、上記目的を達成するため、正極、負極及びこれら正負極間に介在された電解質を備えた燃料電池モデュールの両側に配置され、ガス流通用の溝部が形成された燃料電池用金属セパレーターにおいて、少なくとも上記溝部表面にフッ素樹脂又はフッ化黒鉛粒子が共析した貴金属複合めっき皮膜を形成したことを特徴とする燃料電池用金属セパレーターを提供する。

【0009】この場合、上記貴金属複合めっきは、溝部を含むセパレーター全体に施しても、溝部に貴金属複合めっきを施し、接触部に通常の金めっきなどを施してもよいが、セパレーター全体に貴金属複合めっきを施すことが、作業面、コスト面などから望ましい。

【0010】本発明のセパレーターは、Pt，Au，Pd，Ag等の貴金属マトリックス中にフッ素樹脂又はフッ化黒鉛粒子が均一に分散、共析、複合された貴金属複合めっき皮膜が形成されているため、接触抵抗が小さい上、撥水性が高く、溝部の撥水性が良好で、水分除去が容易になされ、溝に水が付着してガス流路を閉塞させるような不都合はなく、ガスの流通性が良好である。また、耐食性も優れたものである。

【0011】以下、本発明につき更に詳しく説明する。

【0012】本発明の燃料電池用金属セパレーターは、少なくともガス流通用溝部表面に貴金属マトリックス中にフッ素樹脂又はフッ化黒鉛粒子が共析、分散された貴金属複合めっき皮膜が形成されたものである。

【0013】ここで、このセパレーター素材としては、従来公知のものが用いられ、例えばアルミニウム、ステンレススチール、チタンなどを用いることができるが、軽量である等の点でアルミニウム板を素材とすることが好ましい。

【0014】このような金属素材に対して貴金属複合めっきを施す場合は、その素材の種類に応じた公知の前処理、例えばアルミニウム素材に対しては亜鉛置換処理、ステンレススチールやチタンの場合は酸を用いて酸化膜を除去した後、ウッドニッケルめっき液を用いたストライクニッケルめっき処理を行う。

【0015】この場合、このような前処理後、下地めっき皮膜を形成することができ、特にアルミニウムを亜鉛置換処理した場合は下地めっき皮膜を介して貴金属複合めっきを行うことが好ましい。この下地めっき皮膜としては、ニッケル又はニッケルーリン合金等のニッケル合金めっき皮膜を形成することができ、公知の電気ニッケルめっき或いは無電解ニッケルめっき法にて厚さ1～5

0μm程度の下地めっき膜を形成することができる。

【0016】貴金属複合めっきは、Pt，Au，Pd，Ag等の貴金属の水溶性塩を含む公知の電気貴金属めっき液にフッ素樹脂又はフッ化黒鉛粒子からなる共析微粒子（撥水性微粒子）を分散した複合めっき液を用いて行うことができる。

【0017】ここで、共析微粒子として具体的には、フッ化黒鉛、PTFE（ポリテトラフルオロエチレン）、FEP（フルオロネイティッドエチレンプロピレン）、PFA（テトラフルオロエチレン／パーフルオロアルキルビニルエーテル共重合体）、ETFE（エチレン／テトラフルオロエチレン共重合体）、PVDF（ポリビニリデンフルオライド）、ECTFE（エチレン／クロロトリフルオロエチレン共重合体）などのフッ素化した樹脂の微細粉（約0．1～約3μm粒径）が好適に使用できる。

【0018】これらは水に濡れにくいために、公知の界面活性剤を使用して、公知の方法で分散させるとよい。分散及び共析のためには、カチオン界面活性剤が好適に使用できる。カチオン界面活性剤としては、疎水基として、長鎖の炭化水素基を持つもの及びパーフルオロアルキル基を有するものが使用できる。例えば、ドデシルトリメチルアンモニウムブロミド、ドデシルベンジルジメチルアンモニウムクロリド、パーフルオロアルキルトリメチルアンモニウムブロミドなどである。

【0019】なお、これら共析微粒子の使用量は適宜選定され、後述する複合量（共析量）が得られるような量で添加する。

【0020】上記貴金属複合めっき液を用いて複合めっきを行うに際し、共析させる分散粒子を分散させておくのに都合のよい液撹拌、液循環法を使用することが好ましい。めっき液は静置していると、下に沈殿したり、上に浮いたりするので、緩く液循環するのがよい。

【0021】めっき品物は、揺動すると、めっき外観が均一になり易い。その他、液温、pH、電流密度などのめっき条件は、共析粒子を含まないめっき液（マトリックスめっき液）と同様でよい。

【0022】このような貴金属複合めっき液を用いて得られるめっき皮膜は、貴金属マトリックス中に上記共析微粒子が均一に分散、共析されてなるものであるが、共析微粒子のめっき皮膜中への複合量（共析量）は約2～30vol%であることが好ましく、特に約10vol%

%以上の複合量であると、撥水性が高いものである。また、このめっき皮膜は、その表面に共析微粒子が露頭しているものであるが、めっき皮膜を加熱して共析したフッ素樹脂を一部溶融すると、更に撥水性が向上する。

【0023】また、上記めっき皮膜の水との接触角は、フッ素樹脂を共析した場合は約110～60°、フッ化黒鉛粒子を共析した場合は約150～110°である。

【0024】なお、上記めっき皮膜の厚さも適宜選定されるが、0．2～20μm、特に1～15μmである。

【0025】本発明においては、上記セパレーターの少なくとも溝部に上記貴金属複合めっき皮膜を形成するものであるが、この場合、溝部と接触部とに共にこのめっき皮膜を形成することができ、この複合めっき皮膜はマトリックスが貴金属であるため、接触抵抗が低いものであるが、必要により溝部に上記複合めっきを行い、接触部には共析微粒子を含まない貴金属めっきを行い、貴金属めっき皮膜を形成することができる。例えば、溝部にPt／PTFE複合めっきを行い、接触部には金めっきを別々に行ってもよい。しかし、この場合は、レジストを添付してマスクした後に剥離し、更に別場所にレジストを添付しめっきした後に剥離する必要があり、時間、労力がかかり、コストアップになるおそれがあり、従って、溝と接触部を同時にめっきすることが望ましい。

【0026】

【発明の効果】本発明の燃料電池用金属セパレーターは、従来公知のセパレーターと同様の態様で使用することができ、特に固体高分子電解質型の燃料電池のセパレーターとして好適であるが、本発明のセパレーターは、接触抵抗が低く、また溝部の撥水性に優れ、良好なガス流通性が確保され、しかもマトリックスが貴金属であるため、耐食性にも優れるものである。

【0027】

【実施例】以下、実施例を示し、本発明を具体的に説明するが、本発明は下記実施例に制限されるものではない。

【0028】［実施例1］外寸200×184mmのアルミニウム製ガス流通溝付セパレーターを常法に従って下記に示す前処理（亜鉛置換処理，上村工業（株）製AZプロセスを使用）を行った後、下記組成の電気ニッケルめっき液を用いて20μmのニッケルめっき皮膜を形成し、その上に下記組成の電気白金複合めっき液を用いて0．5μmの複合白金めっき皮膜を形成した。

前処理

アルカリ洗浄剤	U-クリーナーUA-68（50g／L，50℃，5分）
	↓ 水洗浄
アルカリ性エッチング剤	AZ-102（50g／L，60℃，30秒）
	↓ 水洗浄
ジスマット　ジスマッター	AZ-201（200g／L）+硝酸（800mL／L）（室温，30秒）

↓ 水洗浄
亜鉛置換　AZ－301（室温，1分）
↓ 水洗浄
硝酸浸漬　硝酸800mL／L（室温，30秒）
↓ 水洗浄
亜鉛置換　AZ－301（室温，1分）

電気ニッケルめっき液及びめっき条件

硫酸ニッケル	285g／L
塩化ニッケル	45g／L
硼酸	40g／L
pH	4．2
液温	55℃
撹拌	空気撹拌
陰極電流密度	5A／dm²
めっき時間	22分間

電気白金複合めっき液及びめっき条件

$H_2Pt(NO_2)_2SO_4$	Ptとして5g／L
PTFE	20g／L
ドデシルトリメチルアンモニウムクロリド	2g／L
硫酸でpH2とする	
液温	40℃
陰極電流密度	0．5A／dm²
陽極	Pt
めっき時間	4分間
撹拌	ポンプ循環による液撹拌

【0029】得られた白金複合めっき皮膜は、白金中にPTFE（ポリテトラフルオロエチレン）が均一に共析、分散しているもので、PTFEの共析量は15vo1%であった。

【0030】このめっきしたセパレーターにカーボン板を載せ、面圧5kgf／cm²でプレスし、このセパレーターのカーボン板との接触抵抗を測定した。その結果、抵抗は全て5～20mΩ×cm²であり、良好であった。更に、腐食環境として、75℃での飽和水蒸気を含む空気に100日間曝した後の接触抵抗を測定したが、接触抵抗の増大は5%以内であった。

【0031】次に、上記セパレーターを16枚重ね、その間に、イオン交換膜を高分子電解質とし、その両側に公知の酸素電極、水素電極を配したモデュールを介装した燃料電池を作成し、100時間の発電試験を行った。＊発電試験後に、上記セパレーターの接触抵抗を測定した結果、接触抵抗の増大は10%以内であり、セパレーターに殆ど劣化がないことが判明した。

【0032】また、上記燃料電池は100時間後も劣化は殆ど認められず、水素と酸素ガスの利用率が殆ど低下しないことが判明した。

【0033】更に、発電試験前後に、上記セパレーター（白金複合めっき皮膜）と水との接触角を測定した結果、接触角は90～100°であり、撥水性は非常に良好であった。

【0034】［実施例2］実施例1の白金複合めっきの替りに、下記組成の電気銀複合めっき液を用いて10μmの銀複合めっき皮膜を形成した以外は実施例1と同様にしてセパレーターを得た。

電気銀複合めっき液及びめっき条件

$KAg(CN)_2$	Agとして20g／L
KCN（フリー）	15g／L
炭酸カリウム	15g／L
PTFE	30g／L
ドデシルベンジルジメチルアンモニウムクロリド	3g／L
液温	25℃
陰極電流密度	1A／dm²
撹拌	ポンプ循環による液撹拌

【0035】得られた銀複合めっき皮膜は、PTFEが※50※20vo1%共析しているものであり、実施例1と同様

の燃料電池を組み立て、同様の試験を行った結果も、実施例1と同様であった。

【図面の簡単な説明】

【図1】燃料電池用金属セパレーターの一例を示す概略図である。

【符号の説明】

1　セパレーター
2　接触部
3　溝部
4　炭素紙

【図1】